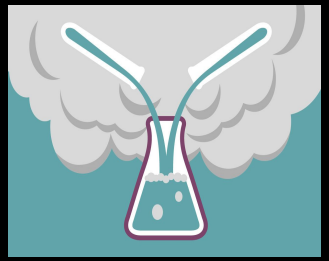
Enriching the STEM System

COD Society of Women Engineers

Researched & Presented by Cierra Desmaratti

What is STEM

Science

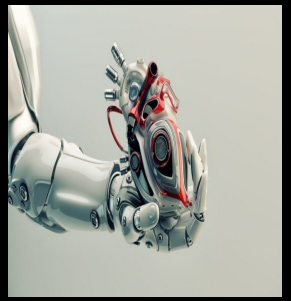


- Astronomy
- Biochemistry
- Geology
- Physics
- Meteorology

Technology

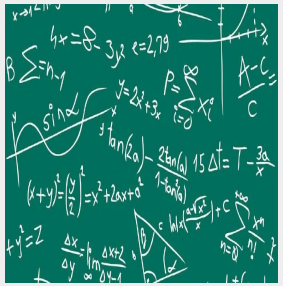
- Software Development
- Web Programming
- Video Game Design
- Computer Science
- IT Systems

Engineering



- Biological
- Chemical
- Computer
- Electrical
- Manufacturing
- Mechanical
- Product Design

Mathematics



- Accounting
- Actuary
- Economics
- Statistics
- Data Analysis

https://www.youtube.com/watch?v=REC-gGdPqeA

What does 'underrepresented minority' mean?

Some groups have disproportionately low representation in science and engineering (S&E) compared to the U.S. population. Groups like Asians and whites have higher representation.

Underrepresented at all levels

Blacks, Hispanics and Native Americans or Alaska Natives account for roughly **31%** of U.S. residents.

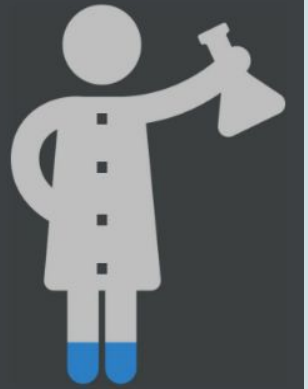
How does that number compare to their representation in science and engineering?

21%

S&E bachelor's recipients

13%

S&E doctorate recipients

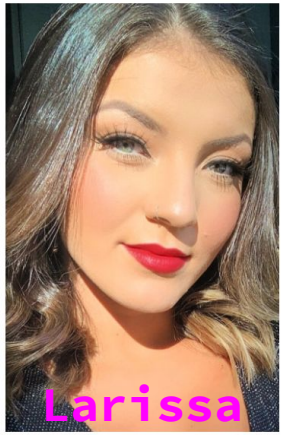


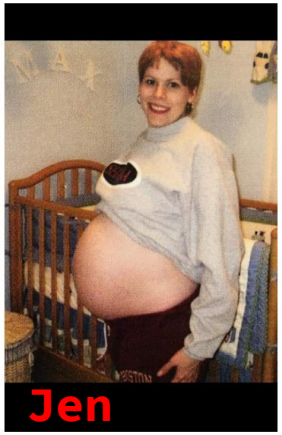
11%

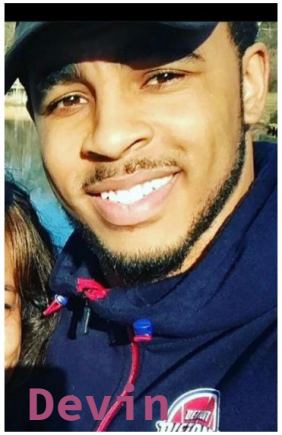
Employment in S&E occupations

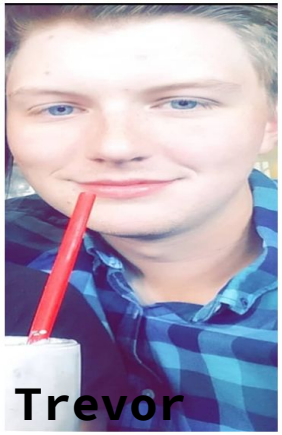
Source: National Center for Science and Engineering Statistics, National Science Foundation
Women, Minorities, and Persons with Disabilities in Science and Engineering: 2017
https://nsf.gov/statistics/wmpd/

Social experiment subjects









Experiment Question: What is a person's perceived STEM capabilities based solely off of their looks?

Activity questions

Choose an image that best represents the answer to following questions:

A. WHICH PERSON HAS PASSED CALC 1, 2 AND 3?

B. FIND THE BIOENGINEER?

C. WHICH INDIVIDUAL APPEARS TO BE A GOOD FIT FOR NASA?

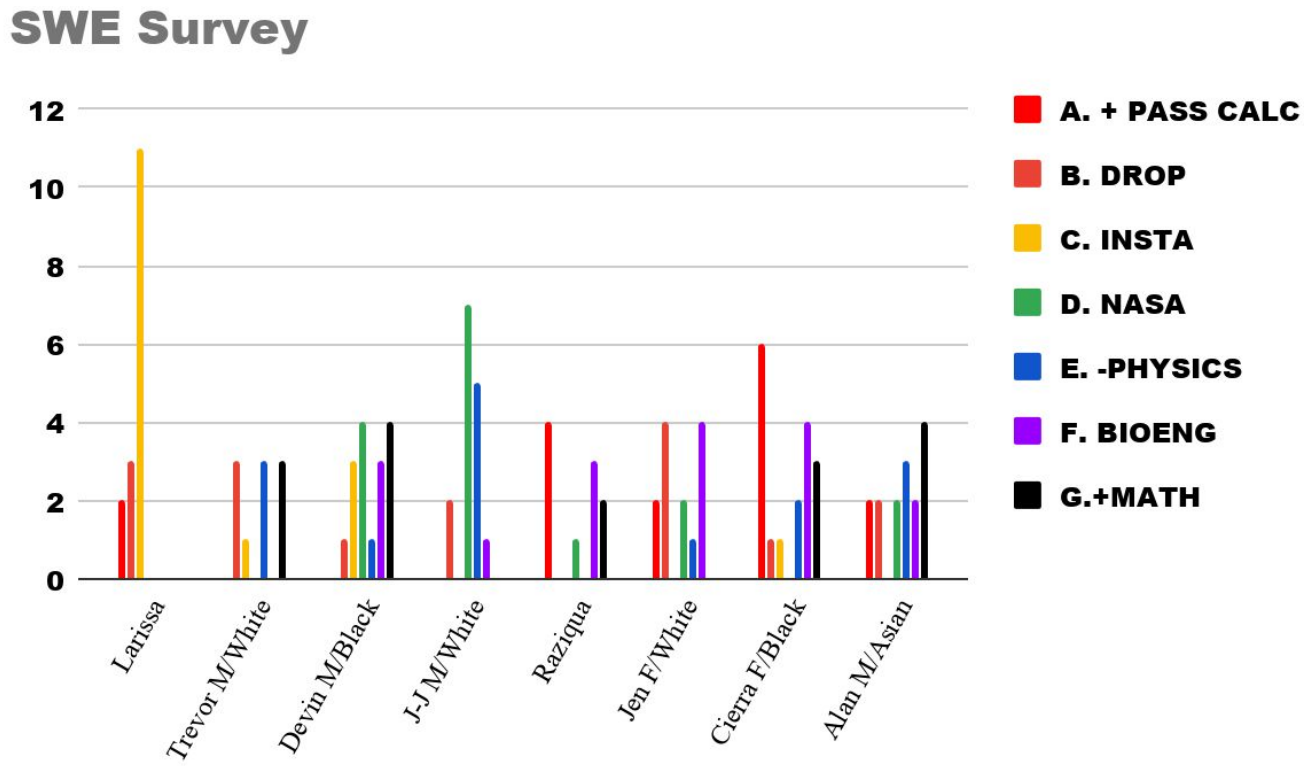
D. WHICH INDIVIDUAL IS BAD AT PHYSICS?

E. WHICH INDIVIDUAL WOULD BE MORE SUCCESSFUL AS INSTAGRAM INFLUENCER THAN A COMPUTER ENGINEER?

F. WHO IS NATURALLY BETTER AT MATH?

G. WHO WOULD DROP OUT OF A STEM MAJOR FIRST?

Our results


SWE Survey
12
10
8
6
4
2
0
Larissa
Trevor M/White
Devin M/Black
J-J M/White
Raziqua
Jen F/White
Cierra F/Black
Alan M/Asian
A. + PASS CALC
B. DROP
C. INSTA
D. NASA
E. -PHYSICS
F. BIOENG
G.+MATH


Larissa


Jen


Raziqa

ANALYSIS OF RESULTS

- Larissa: show that her looks lead others to perceive her as not being qualified for the STEM field.
- We need to need to understand that women are capable of being maternal figures and conquering challenging STEM degrees and advanced positions
- Raziqa - only person that was not voted for the dropping out of STEM category, becoming a social media star, or being bad at physics
    - She emulates the perception that Asian people are skilled in math and sciences.

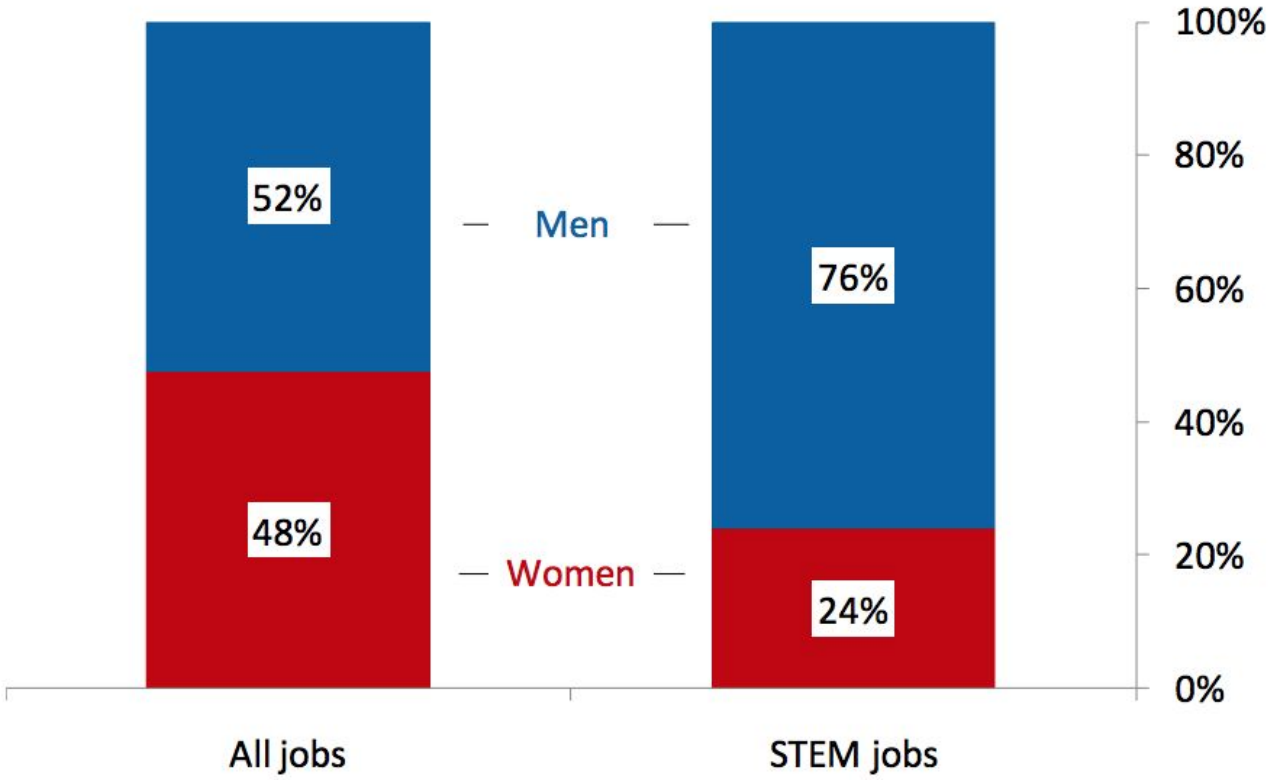
Stats on women in stem Workforce

- Women makeup half of the total U.S college-educated workforce
  - Only ~25% of the science and technology workforce

- Women in STEM Career:
  - 15% Engineering
  - 26% Computer & Mathematical Sciences

- Only 30% of female engineers are still working in field after 20 years.
- 30% leave due to “professional climate”

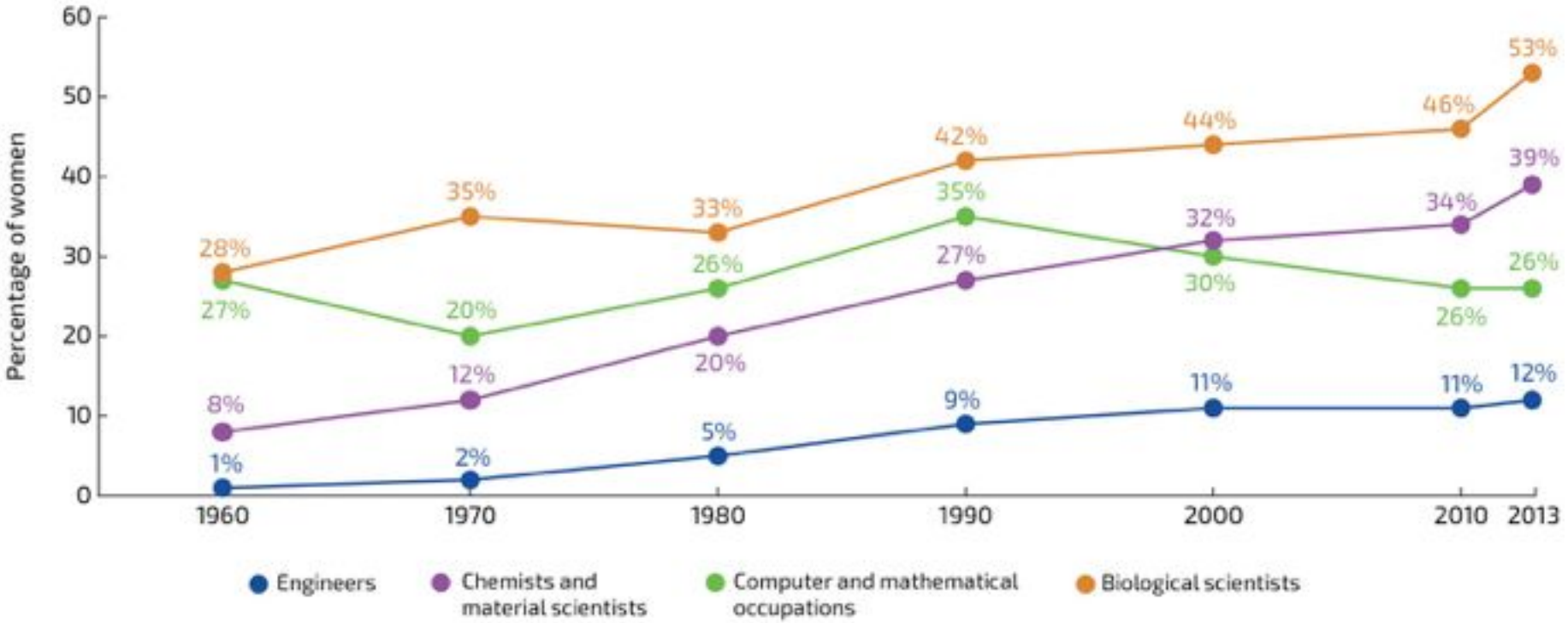
Figure 1. Gender Shares of Total and STEM Jobs, 2009



Source: ESA calculations from American Community Survey public-use microdata.
Note: Estimates are for employed persons age 16 and over.

https://files.eric.ed.gov/fulltext/ED523766.pdf

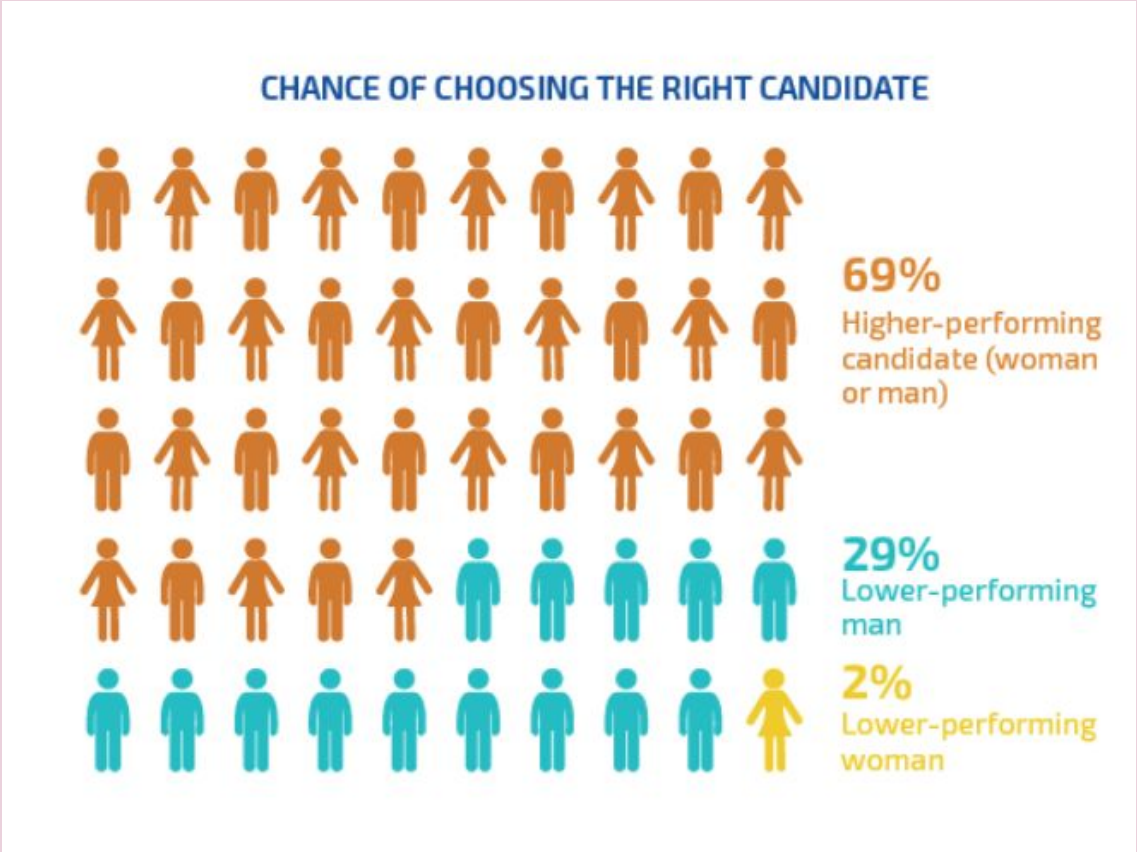
FIGURE 1. WOMEN IN SELECTED STEM OCCUPATIONS, 1960–2013



https://www.aauw.org/resource/solving-the-equation-powerpoint-presentation/

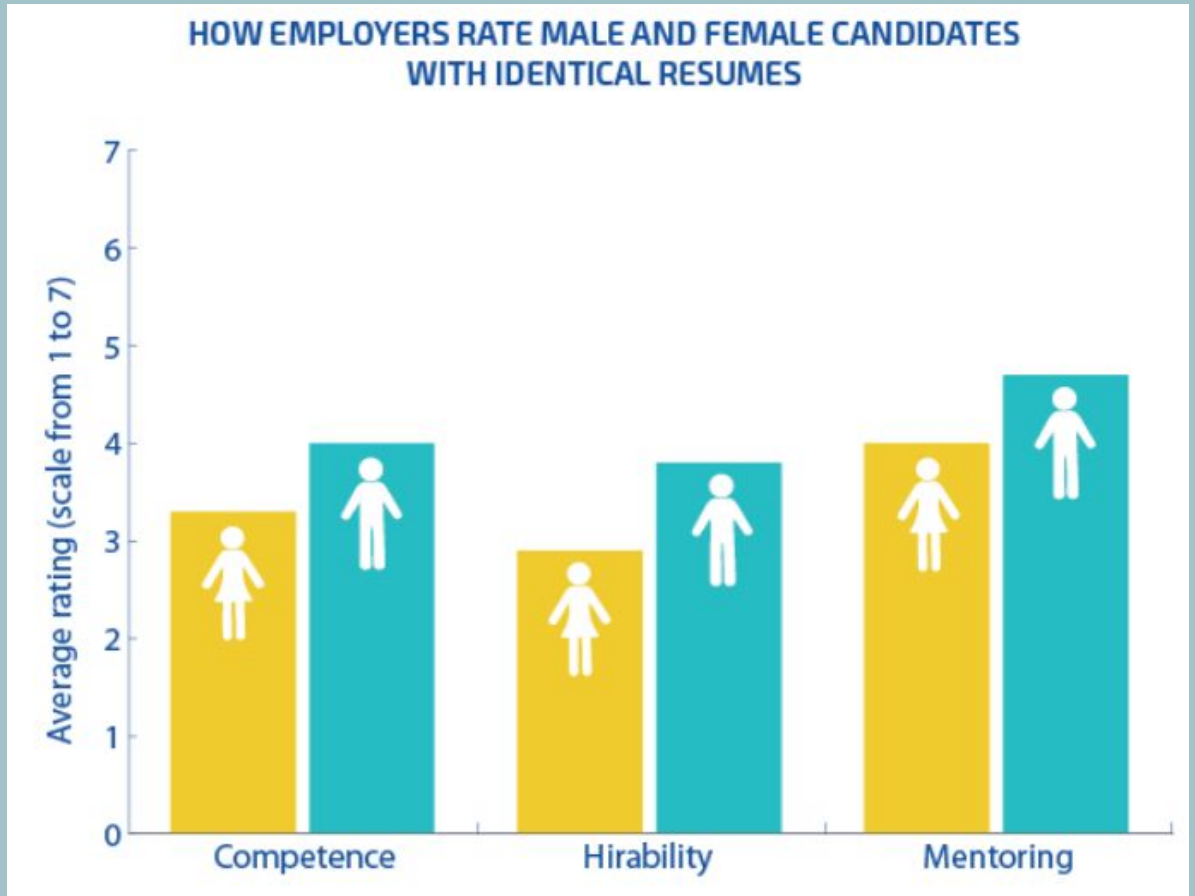
Research experiment Results:

- **Study 1:** Science faculty hiring equally qualified candidates.



https://www.aauw.org/research/solving-the-equation/

- **Study 2:** Science faculty hiring candidates with varied performance levels.

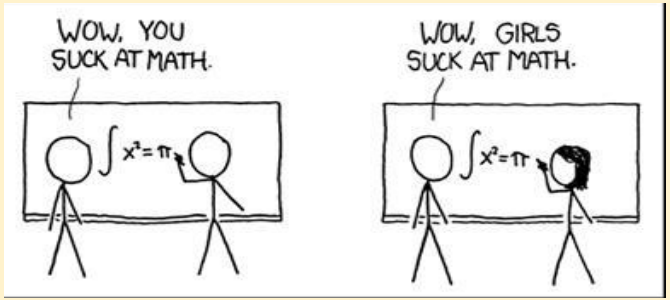


- **Female**
- **Male**

https://www.aauw.org/research/solving-the-equatio

Females in Stem Higher Education

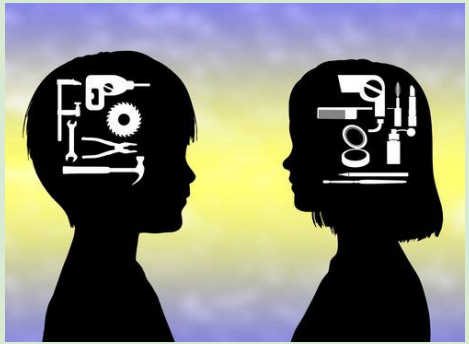
- Freshman intention: Men (26.9%) Women (7.9%)
- Over **32%** of females will leave the program.
- Female college students are **1.5 times** as likely to leave STEM after taking the first course in the calculus series.
- Females **lack of confidence in math ability**, main reason not pursuing STEM.
- Male college students are more likely to take engineering and computer sciences.



Female students K-12

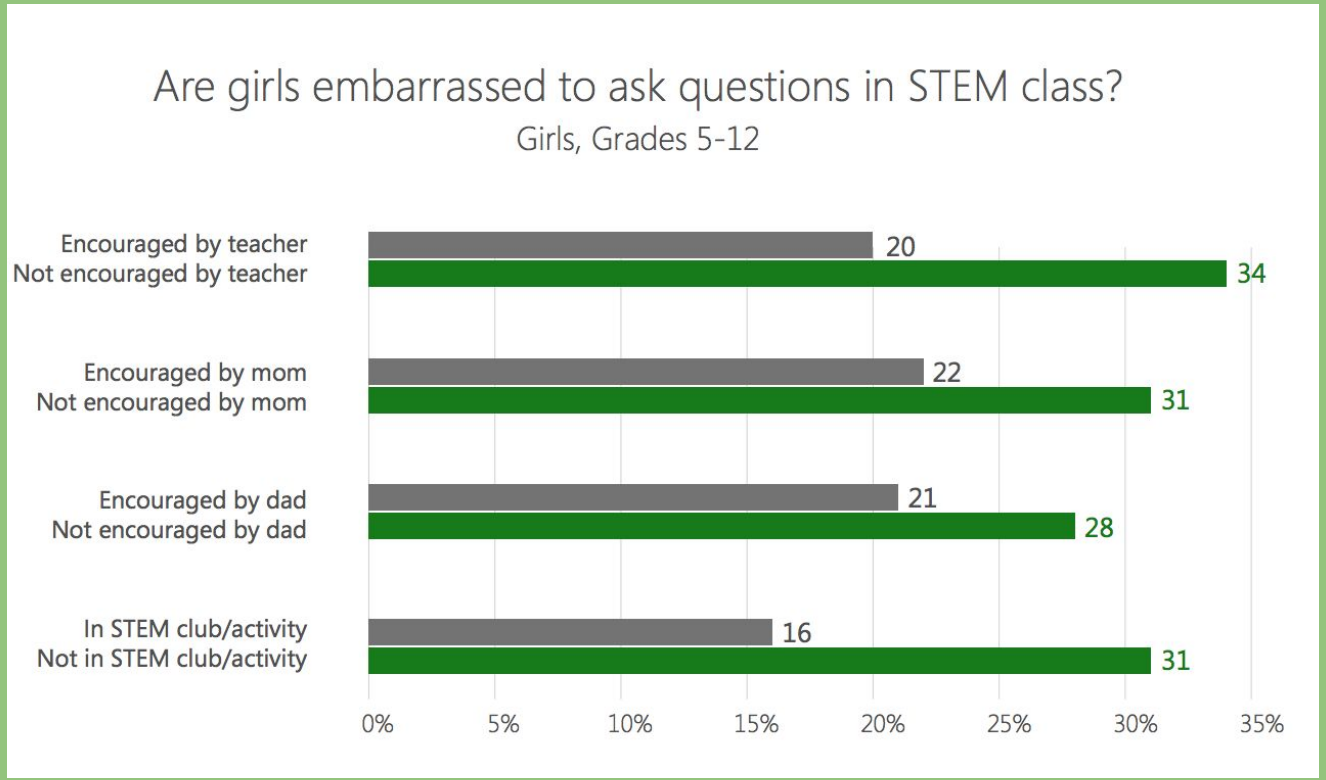
- Females perform equally as well in mathematics & science on standardized tests, as male peers.
- Males & Females take higher math & science courses at same rate.

- Stereotypes & biases
  - From ages 3-5, girls can develop gender bias
    - Demonstrated in movie & tv
    - Taught socially
  - Parents & teachers can hold bias’

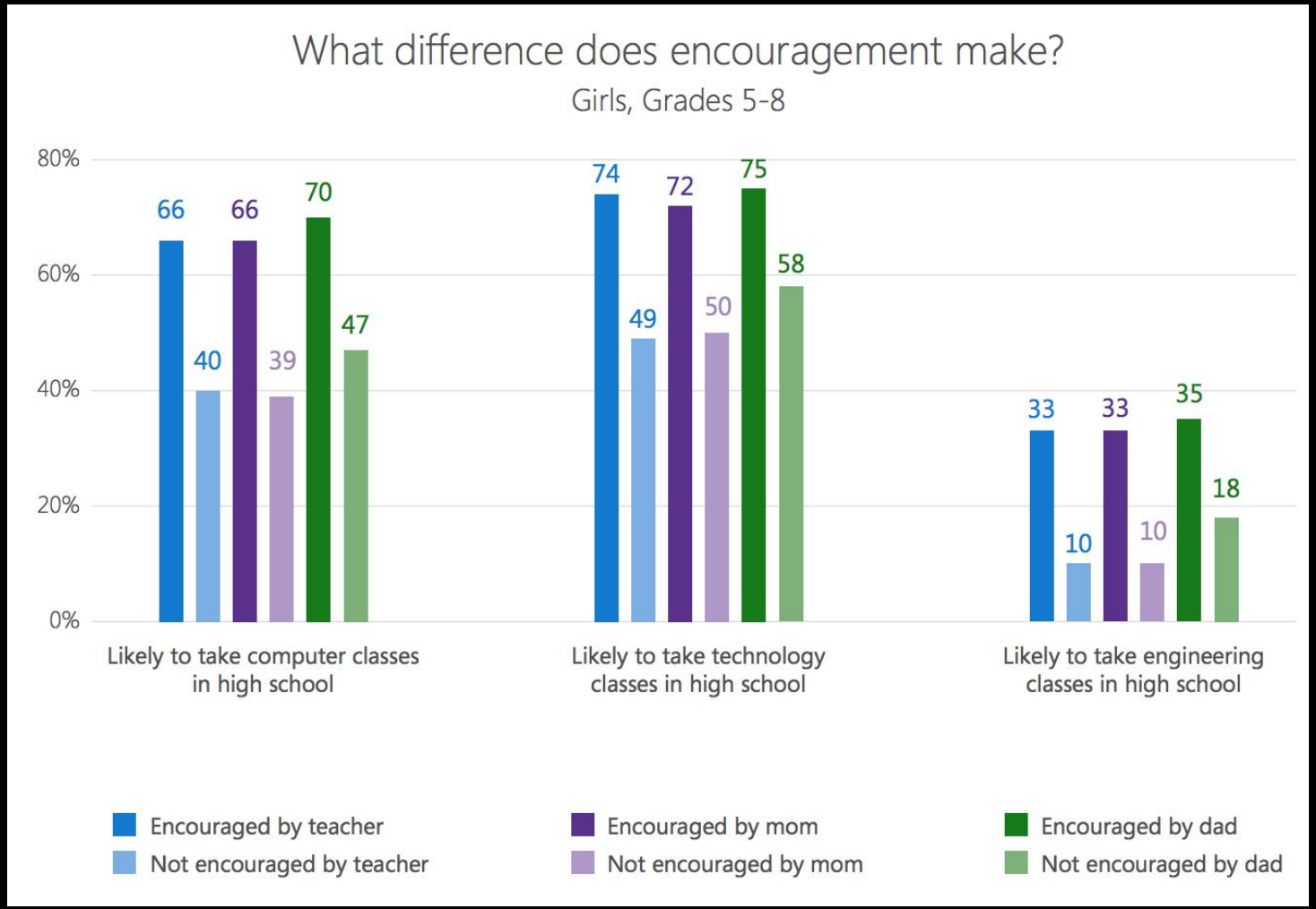


➢ Lack of encouragement leads to lack of interest and effort in math and science.

Encouragement Matters



https://www.ncgs.org/wp-content/uploads/2018/04/Girls_In_STEM-Whitepaper.pdf



https://www.ncqs.org/wp-content/uploads/2018/04/Girls_In_STEM-Whitepaper.pdf

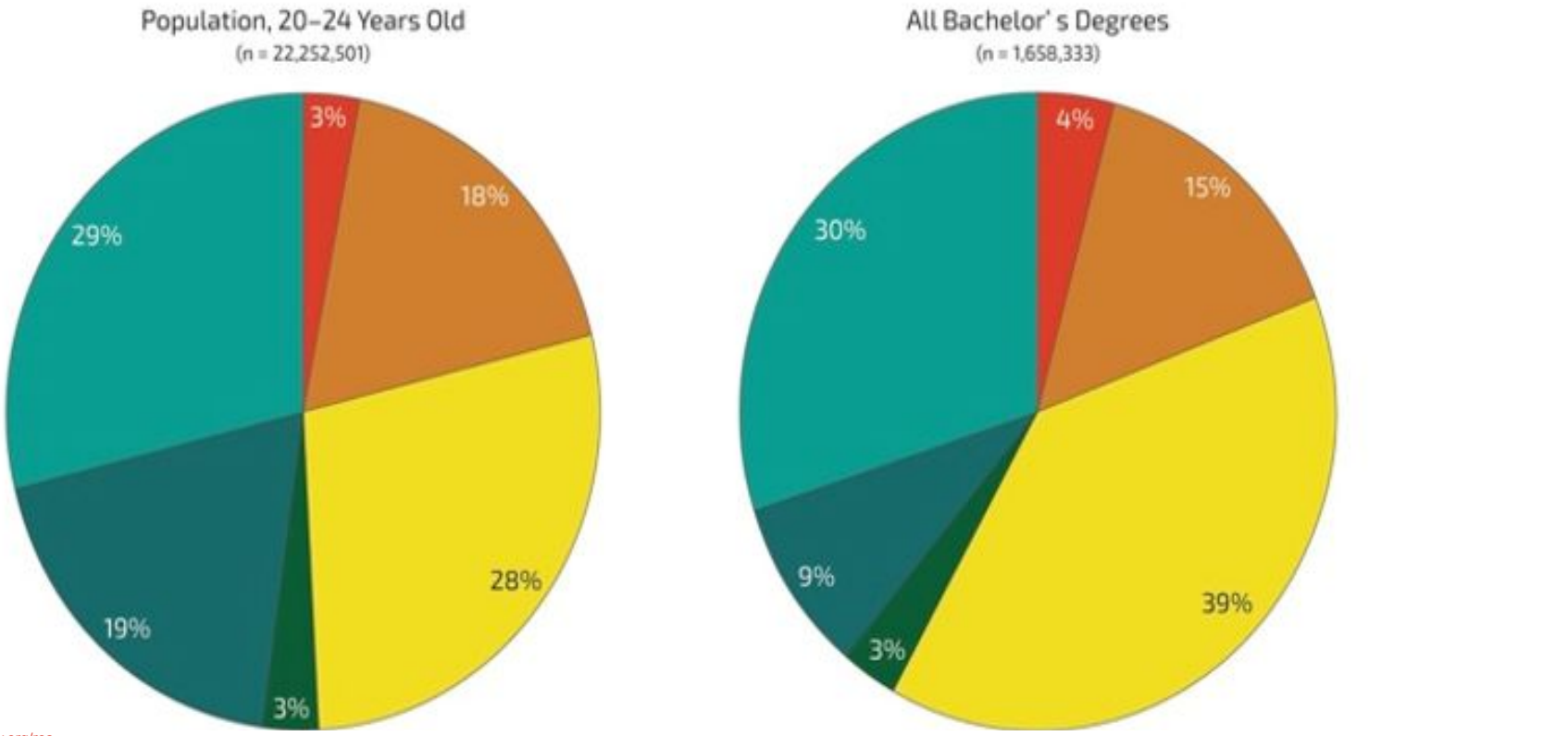
Minorities in Stem Workforce (2015)

- 11% of workers in Science & Engineering are Hispanic, Black, and Native Americans.
  - 67% of STEM Workforce is white

Race and ethnicity	S&E occupations	S&E highest degree holders	College degree holders	U.S. residential population[a]
Total (number)	6,407,000	13,497,000	45,941,000	231,875,000
American Indian or Alaska Native	0.2	0.3	0.3	0.6
Asian	20.6	15.1	8.7	5.5
Black	4.8	6.4	7.5	11.8
Hispanic	6.0	8.4	8.2	14.9
Native Hawaiian or Other Pacific Islander	0.2	0.3	0.4	0.1
White	66.6	67.6	72.9	65.6
More than one race	1.6	1.9	2.0	1.5

https://nsf.gov/statistics/2018/nsb20181/report/sections/science-and-engineering-labor-force/women-and-minorities-in-the-s-e-workforce

FIGURE 9. POPULATION AGES 20–24 AND BACHELOR'S DEGREES AWARDED IN SELECTED FIELDS, BY RACE/ETHNICITY AND GENDER, 2013



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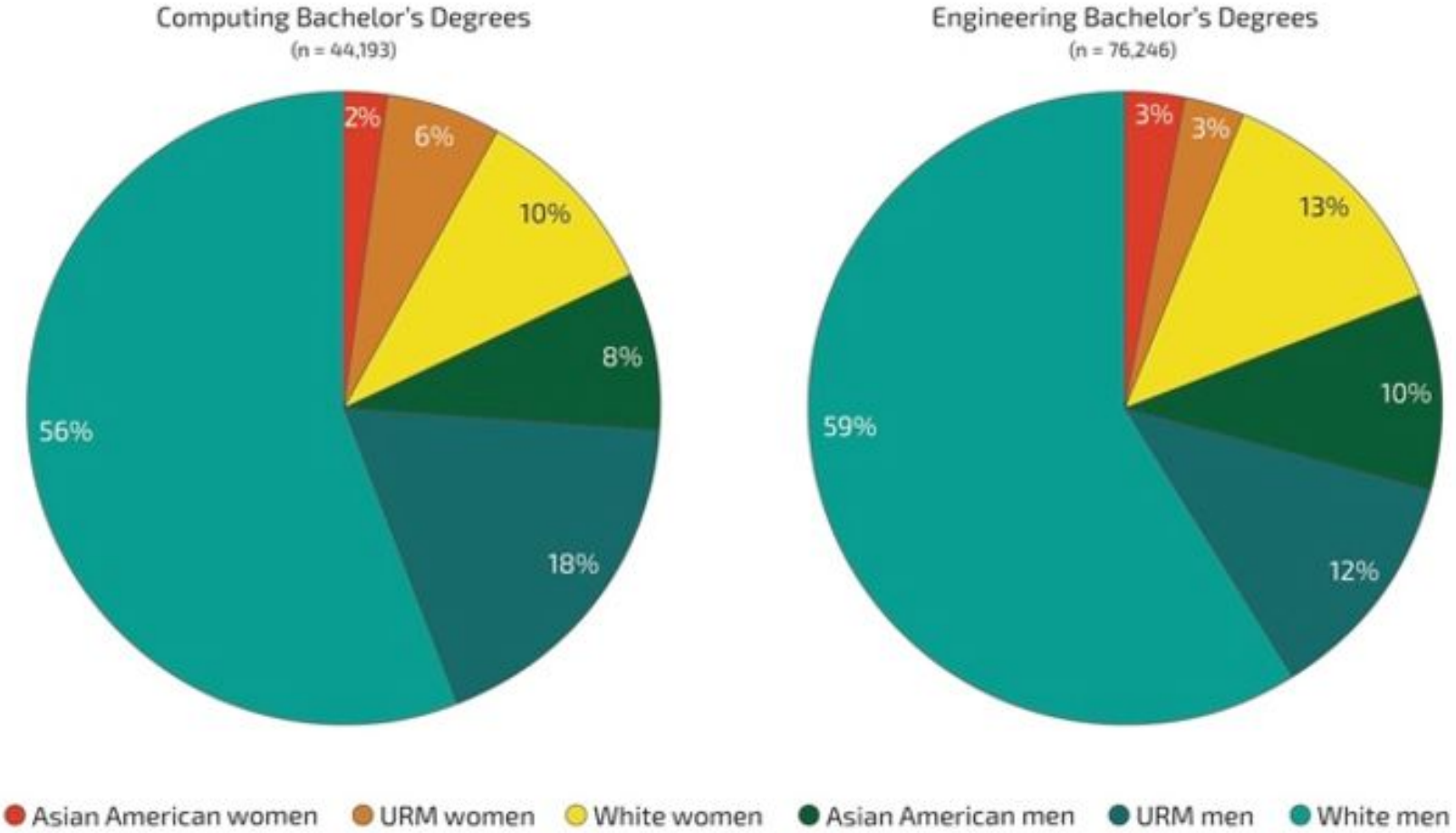


https://www.aauw.org/resource/solving-the-equation-powerpoint-presentation/

Looks matter : Asian american

Looks matter : African american

Hidden figures

- It is important to realize that race is not a categorical factor - we cannot group a variety of people under one category
- “Race is continuous” - people’s perception of an URM’s intelligence depends on how stereotypically they look like their race

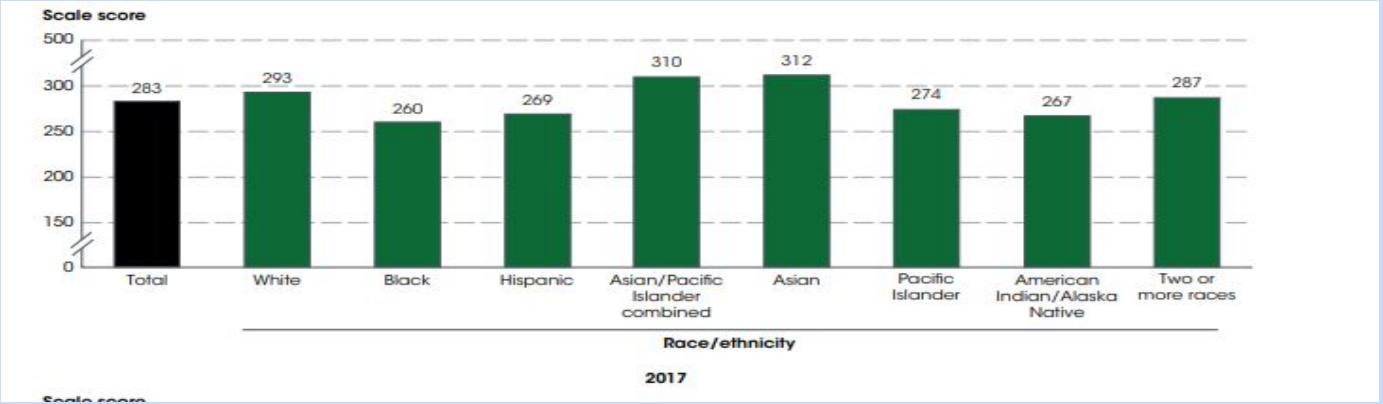
- Stereotypically-black women face the worst prejudice and are are perceived to be lacking in STEM ability
- The higher institution system fails to support black women and retain them in the STEM field

Inequality in the K-12 system

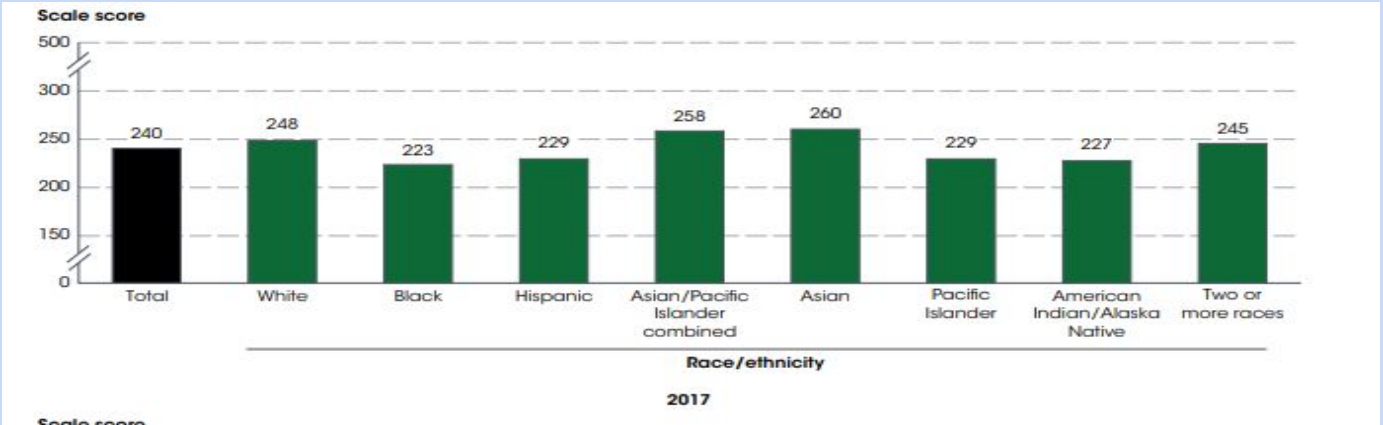
"in contemporary times, one of the primary and most powerful mechanisms through which the in-group creates and maintains such advantages is the construction and perpetuation of stereotyped assumptions and beliefs regarding the attributes of members of the out-group, which are then used to justify their exclusion" (Anderson, 2010; Lewis & Diamond, 2015)

Opportunity hoarding - advanced classes are primarily filled up by White and Asian students, leaving minorities to find their place in the education system and are underprepared for college

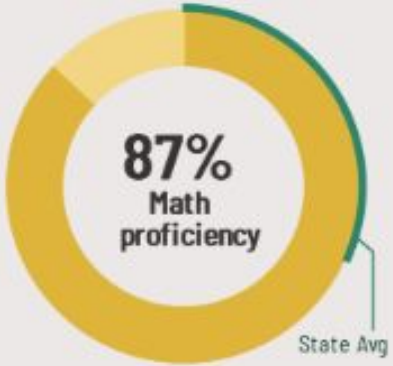
GRADE 4 MATH PERFORMANCE

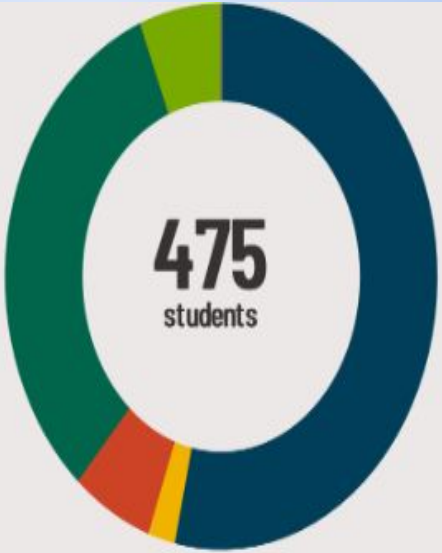


GRADE 8 MATH PERFORMANCE



Example: Meadow Glens of Naperville, IL





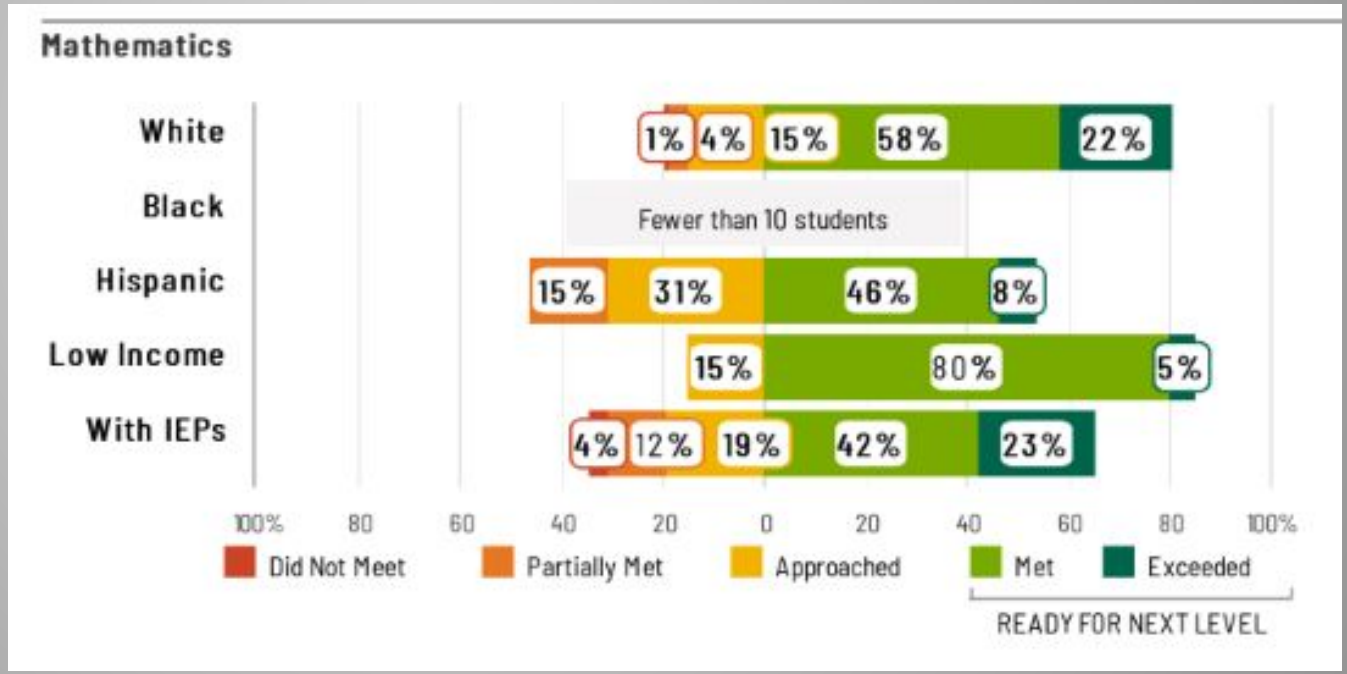
Student Characteristics

White	53%
Black	2%
Hispanic	6%
Asian	32%
American Indian	0%
Two or More Races	6%
Pacific Islander	0%
Low Income	7%
English Learners	6%
With IEPs	10%
With Disabilities	-
Homeless	0%

www.naperville203.org/Page/4177

Minorities are left behind in the rich and poor zip codes

- ONLY 54% OF HISPANICS ARE READY FOR THE NEXT MATH LEVEL



www.naperville203.org/Page/4177

How minorities in STEM suffer in college

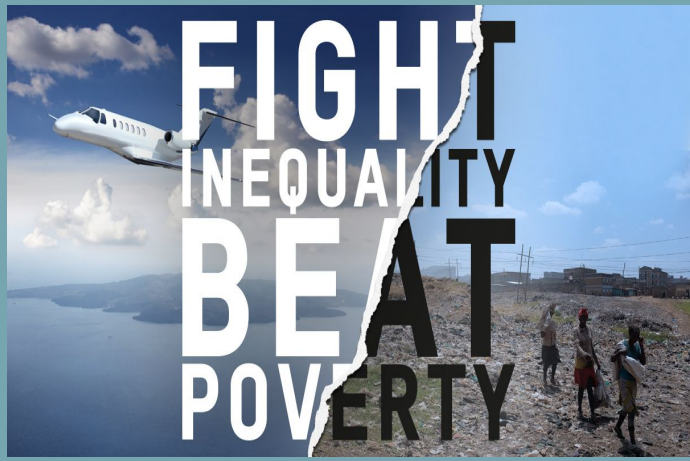
- **“higher switching rates for minority students relative to White students is a pattern that is indeed specific to STEM fields” (Riegle-Crumb)**
- The lack of academic preparation in high school explains the ratio of latino/a students that leave college or switch from STEM majors in comparison to white students
- For Black students the lack of academic preparation does not even begin to explain the gap between departure rates for black and white students

WHY DO PEOPLE LIKE ME JOIN STEM?

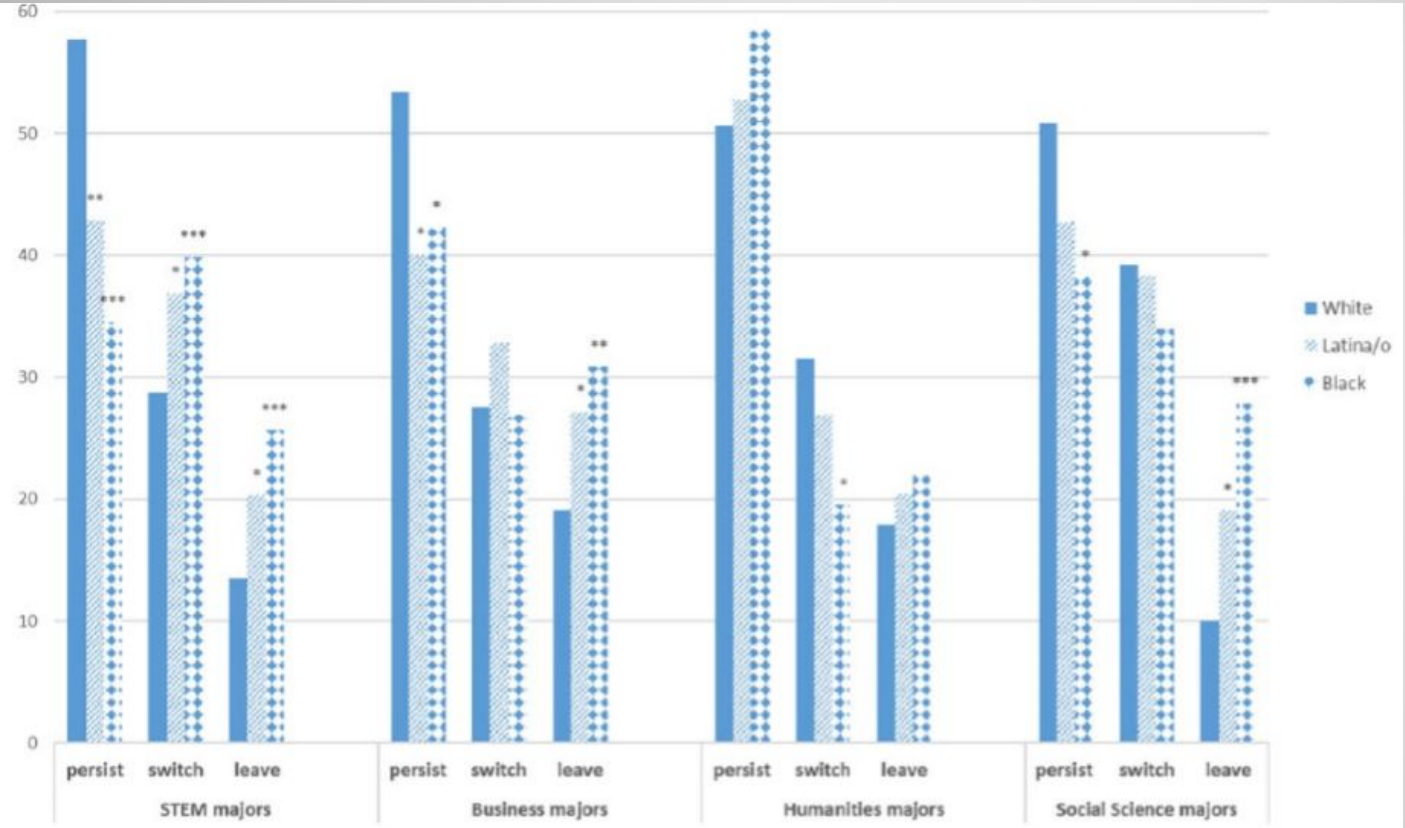
African American Women are **less likely** to fall prey to gender-stereotypes in STEM

  - Show a much weaker belief in implicit gender-stem stereotypes than European-American women

- URM Students going into stem want to mentor future stem majors of color so they don't experience the same sexism or racism they did
- **Equity oriented stem pursuit**



Rates at which minorities and White students leave and persist in STEM compared to business, Humanities & ss



Whites

Persist: 57%
Switch/leave: 43%

Latino/a

Persist: 42%
Switch/leave: 57%

Black

Persist: 35%
Switch/leave: 65%

Riegle-Crumb, Catherine, et al. "Does STEM Stand Out? Examining Racial/Ethnic Gaps in Persistence across Postsecondary Fields." *Educational Researcher*, vol. 48, no. 3, Apr. 2019, pp. 133–144. *EBSCOhost*, search.ebscohost.com/login.aspx?direct=true&db=eric&AN=EJ1212753&site=ehost-live.

The STEM system is unjust

STEM has the HIGHEST presence of prejudices and stereotypes out of any college major and field

We must make the STEM

Field a more inclusive

And supportive environment for all

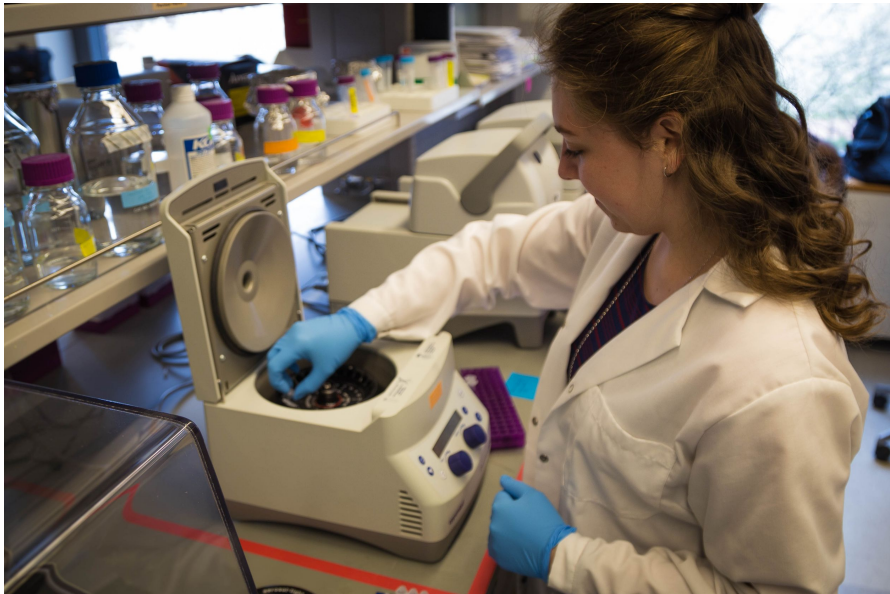
Ethnicities and genders

Creativity is the key to creating innovative leaders

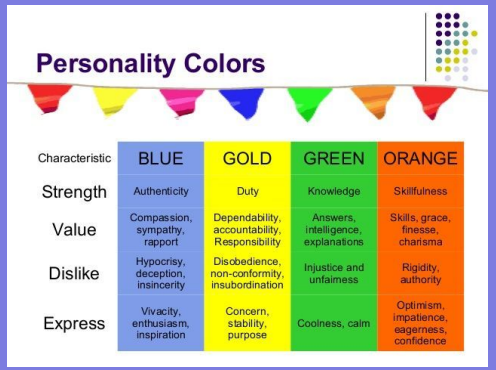
- Engineering needs creative, driven leaders that will innovate the future!
- “people who believe their jobs require creativity rise to the challenge and generate more creative solutions to real-world problems”
- Misconceptions about science:
  - There is no sense of community
  - Scientists are not empathetic
  - STEM is only for antisocial people
  - Scientists work in isolated labs by themselves

Women are born to lead

- Girls deter from entering STEM because they believe it is boring and not creative enough!
- Most males in STEM do not see creativity as a valuable trait



Diverse personalities = unlimited solutions



Personality Colors

Characteristic	BLUE	GOLD	GREEN	ORANGE
Strength	Authenticity	Duty	Knowledge	Skillfulness
Value	Compassion, sympathy, rapport	Dependability, accountability, Responsibility	Answers, intelligence, explanations	Skills, grace, finesse, charisma
Dislike	Hypocrisy, deception, insincerity	Disobedience, non-conformity, insubordination	Injustice and unfairness	Rigidity, authority
Express	Vivacity, enthusiasm, inspiration	Concern, stability, purpose	Coolness, calm	Optimism, impatience, eagerness, confidence

- Dependable
- Organized
- punctual

- Knowledgeable
- Curious
- Creative thinkers

- Compassionate
- Empathetic
- Value rapport

- Risk taker
- Optimistic
- Charismatic
- energetic

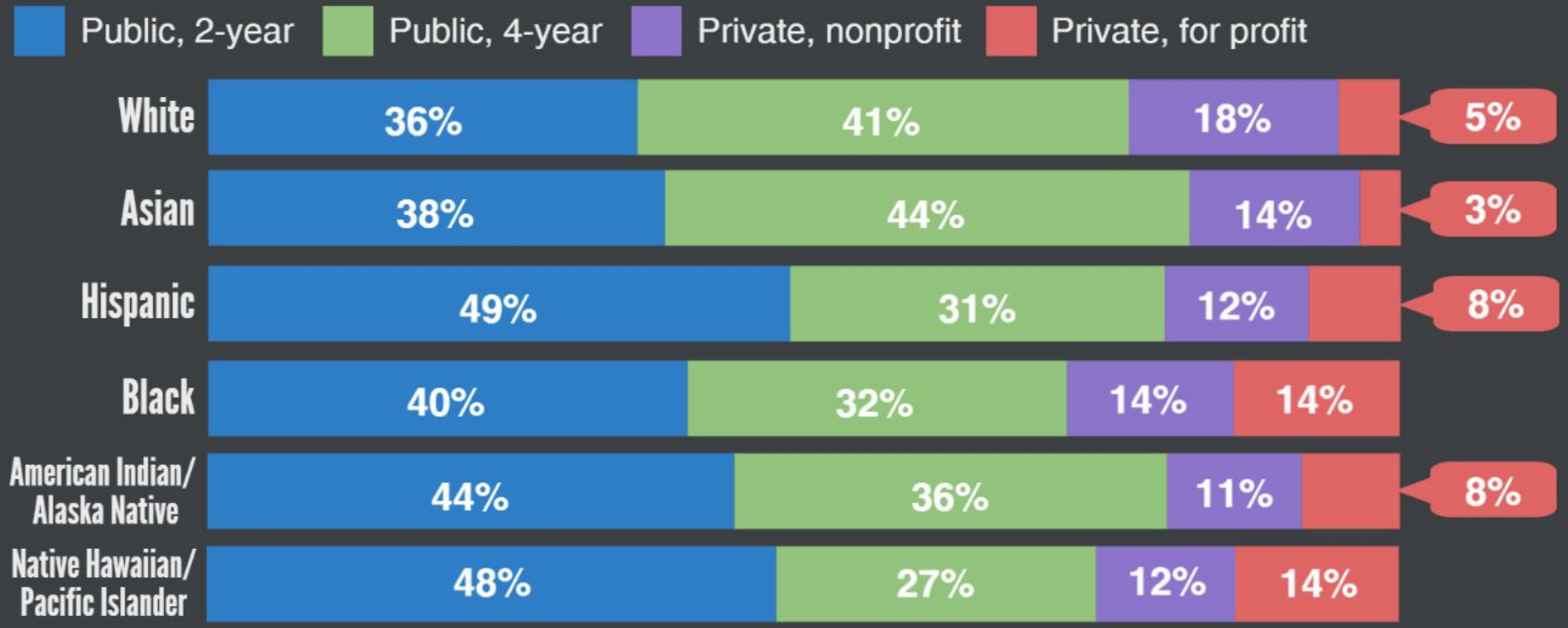
Diversity is the future

We need all types of “colors” in STEM!

We cannot create a diverse economy and remain a world leader in technology without uniting the unique and cunning minds out there!

What types of colleges do different groups attend?

In 2014, as in past years, undergraduate enrollment patterns varied among racial and ethnic groups.



Source: National Center for Science and Engineering Statistics, National Science Foundation
Women, Minorities, and Persons with Disabilities in Science and Engineering: 2017
https://nsf.gov/statistics/wmpd/

How can you get involved in STEM

- Participate in STEM programs offered at school
- Connect with people in the field or program
- Research & Follow positive role models
- Persist in STEM courses
  - Ask for help
    - Visit professor office hours
    - Go to tutoring centers at school
  - ask questions in class
  - Form study groups with peers

How to Encourage Women & minorities in STEM:

- Emphasize the creative aspects of STEM and computer science.
- Demonstrate the dramatic impact that STEM and computer science jobs have on the world.
- Encourage parents, teachers and others influential in a girl's life to support and foster interest in STEM and computer science.
- Support teachers to develop strategies to engage students who are afraid to ask questions, be wrong or ask for additional help.
- Listen to what girls say about their challenges and desires.
- Provide more exposure to positive role models and mentors they can both relate to and aspire to be.
- Demonstrate a path forward in terms of turning an interest in STEM and computer science into success in school and in a career.
- Support extracurricular STEM activities that teach girls how to create and build confidence.
- Provide hands-on experiences and real-world examples.

Promoting STEM diversity at COD

- **Understand** the campus/classroom climate from the perspective of minoritized groups
- **Empathize** with the discomfort URMs and women
- **Offer mentoring** especially for women and minorities since this is atypical for these groups
- Present a diverse array of opportunities
- EACH MINORITY MUST FEEL THAT THEIR IDENTITY IS VALID

Cont.

- Faculty who incorporate a more **equity ethics** based methodology to teach
  - **Equity ethics: Having a concern for helping others**
  - Wanting to give back to a larger community and give back at home
- Focus on recruiting black and latino faculty
- Marketing issue; more images of role models putting their tech into action
- We need more empathy-like projects
  - Ex: Engineering without borders
- Diversity of thought, talent, and background

Works cited

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